which the Ferroux borer was worked; while on the western side pumped water was pressed through pipes to the tension of over a hundred atmospheres, to work the Brandt turning borer, which cuts cylindrical blocks of rock from the mountain. The eastern entrance to the Arlberg Tunnel—namely, St. Anton—is 1300 metres above the level of the sea, while the western entrance is only 1215 metres, by which difference a good ventilation of the future railway tunnel seems secured. The vaulting and all other necessary works will be finished at the latest on August 1, 1884.

A MEETING has been held at Chester, presided over by the Duke of Westminster, to take steps to provide the city with a museum, which is intended to be a centre of scientific information for Cheshire and North Wales. North Wales was represented at the meeting by the Duchess of Westminster, Earl Grosvenor, and Sir Robert Cunliffe, Bart.; the Chester Natural Science Society by its president, Prof. T. McKenny Hughes; and the Chester Archæological Society by Dean Howson and Mr. H. Tollemache, M.P. It was decided that the building should accommodate both these societies and the School of Art. The Duke of Westminster announced his intention of giving the greater part of the proposed site, and 4000*l.* towards the building fund.

THE Council of the New University College of South Wales, at Cardiff, have resolved to try to raise 3000*l.* for mechanical laboratories.

THE inaugural meeting of the International Electrical Association took place in Paris on the 15th in the large hall of the Société d'Encouragement. M. Cochery was voted by acclamation Honorary President, and M. Berger Acting President. The number of adhesions exceeds 1000.

THE following is an illustration of what private enterprise may effect for the benefit of science. When the Swedish ship *Monark* was leaving Sweden last year for Australia the second officer on board applied to the Zoological Museum at Upsala for the loan of a trawl and some vessels for preserving natural history objects. The results have been a collection of some 120 species of fish, 50 of insects, some birds, and about 100 varieties of the lower sea fauna of the Pacific, which have now arrived at Upsala.

ON November 2 the Imperial Russian Academy of Science celebrated its hundredth year with great ceremony. Count Tolstoy, the President and Minister of the Interior, acted as chairman.

MR. GAMÉL of Copenhagen has placed the *Dijmphna* at the disposal of Lieut. Hovgaard for an Arctic expedition next year.

AT the Royal Institution Prof. Dewar will give six lectures at Christmas (adapted to a juvenile auditory) on "Alchemy in Relation to Modern Science." Before Easter, 1884, courses of lectures will be given by Mr. R. Stuart Poole, Professors McKendrick, Pauer, Tyndall, and Henry Morley, Capt. Abney, and others. The programme of the Friday evening arrangements will be issued shortly.

A SLIGHT shock of earthquake was felt on Friday at Malaga. A shock was also felt at Chios on the 16th. An earthquake occurred on the 19th at Vallo della Lucernia in the province of Salerno, Italy.

THE additions to the Zoological Society's Gardens during the past week include an Ourang-outang (*Simia satyra* ♂) from Borneo, presented by Mr. William Cross; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Mrs. F. R. Flindell; a Hobby (*Falco subbuteo*), captured at sea, presented by Mr. C. Heat; six American Box Tortoises (*Terrapene carinata*), a Stinkpot Terrapin (*Aromochelys odorata*), seven Spotted Lizards (*Holbrookia maculata*), a Long-nosed Snake (*Heterodon nasicus*), two Striped Snakes (*Tropidonotus sirtalis*) from North America, presented by Mr. Samuel Garman, C.M.Z.S.; a Common Viper (*Vipera berus*), British, presented by Mr. W. H. B. Pain; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, a Cerastes Viper (*Vipera cerastes*) from Egypt, deposited; a Sykes's Monkey (*Cercopithecus albigularis*) from East Africa, a Negro Tamarin (*Midas ursulus*) from Guiana, an Indian Badger (*Arctonyx collaris*) from Assam, two Père David's Deer (*Cervus davidianus*) from Northern China, a Downy Owl (*Pulsatrix torquata*) from South America, purchased; a Sambur Deer (*Cervus aristotelis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

BRORSEN'S COMET.—Of the known comets of short period, two will arrive at perihelion in 1884, viz. D'Arrest's on January 13, and Brorsen's about September. The former has been sought after for several months, but hitherto, so far as we are aware, without success, and there now seems a probability that (as indeed was rather to have been anticipated) it will pass unobserved at this return. The second comet was discovered by Brorser, an amateur at Kiel, on February 26, 1846, and ten days' observations sufficed to show that its period of revolution was about five and a half years: it afforded one of the most striking instances of a close approximation to the period being deduced from a short course of observation, Mr. Hind having inferred a revolution of 5·519 years from observations between February 28 and March 10 (*Astron. Nach.*, No. 557), while the exact period at the time is now known to have been 5·568 years. The comet has been since observed at its returns in 1857, 1868, 1873, and 1879, though missed in 1851 (perhaps through some confusion as to the date of perihelion passage), and again in 1863. The ephemeris for the last appearance in 1879 was prepared by Prof. L. R. Schulze of Dobeln, after the calculation of planetary perturbations since the return in 1873, the perihelion passage being fixed to March 30·0771 Greenwich M.T. The computed positions differed considerably from those observed, as was shown in M. Otto Struve's comparison with his own observations (*Bulletin de l'Académie des Sciences de St. Petersbourg*, t. v.), and these differences led him to remark:—"Eine Änderung in der angenommenen Perihelzeit würde für sich allein wahrscheinlich nicht genügen." It will be found, however, at the end of April or beginning of May. The errors may be removed by the assumption of a later time of perihelion passage; or by taking it March 30·5418 Greenwich M.T., a difference of + 0·4674d. from the computed epoch. Thus for the observation on April 30, we find, taking the differences in the order (c − o):—

	Δα	Δδ
By ephemeris	+ 1m. 38s. ...	+43″·8
With corrected perihelion	− 0m. 6s. ...	+ 0″·2

The mean sidereal motion determined by Dr. Schulze for 1879 would, without perturbation, bring the comet to perihelion again about 1884, Sept. 14·5, at which time it would be situate in about right ascension 154° with 14° north declination, distant from the earth 1·41, consequently rising more than two hours before the sun. The conditions are therefore likely to approach those under which the comet was observed in 1873.

Some six months after the discovery of this comet in 1846 attention was directed by Mr. Hind (*Astron. Nach.*, No. 582, and in a note to the Royal Astronomical Society) to the near approach which it must have made to the planet Jupiter in May, 1842, a first calculation indicating that on May 20 the distance between the two bodies was less than 0·05 of the earth's mean distance from the sun. This point was more closely examined by D'Arrest from improved elements in 1857 (*Astron. Nach.*, No. 1087); he found that the closest proximity occurred May 20·6924 Berlin M.T., when the comet was distant from the planet only 0·05112, and, carrying his computation backwards to the time when the comet entered the sphere of activity of Jupiter, he assigned approximately its elements previous to that time. A more elaborate investigation of the circumstances attending this near approach has been lately made by Dr. Harzer, in an inaugural dissertation published at Leipzig in 1848; he finds for the time of perijove passage, 1842, May 27·2849 Berlin M.T., and for the distance 0·05471; the ele-

ments prior to the great perturbation in this year are determined, and have been already transcribed in NATURE; they present a resemblance to those of the first comet which appeared in 1798, about which year Brorsen's comet might have been in perihelion; Dr. Harzer nevertheless expresses the opinion that, although Messier's observations of the comet of 1798 might be open to some degree of uncertainty, it is doubtful whether they would admit of being represented by an elliptical orbit with a short period. He had found the revolution prior to 1842 to be 5·170 years.

THE NAUTICAL ALMANAC.—The volume of this ephemeris for 1887 has been published during the past week, the contents being generally the same as in previous years. The track of the total solar eclipse of August 19 is given in detail for the greater part of the course, and the maximum duration of totality is found to be 3m. 50s., the central eclipse with the sun on the meridian falling in longitude 102° 0′ E. and latitude 53° 47′ N. The Greenwich list includes four occultations of *Aldebaran* during the year and one of *Regulus*.

The average annual sale of the *Nautical Almanac* during the last five years has exceeded 15,500, though many maritime nations have now their nautical ephemeris.

THE PHILOSOPHICAL SOCIETY OF GLASGOW

THE *Proceedings* for 1882-83, pp. 592, 23 plates, and 3 maps, have just been issued, and contain the following papers:—On insensibility arising from a deficiency of oxygen in the air, by Dr. Wallace, president; on technical education, by David Sandeman and E. M. Dixon, B.Sc.; on the decay of building stones, by Dr. Wallace; on some new infusoria, by William Milne, M.A.; note on Lippmann's capillary electrometer, by Dr. McKendrick; on milk and milk pollution, by Dr. John Dougall; on Struther's process for pulverising diamondiferous ore, by Wallace Fairweather, C.E.; on the use of litmus, methyl orange, phenacetolin, and phenolphthalein as indicators, by R. S. Thomson; on approximative photometric measurements of sun, moon, cloudy sky, and electric and other artificial lights, by Sir William Thomson; on the preservation of food by cold, by J. J. Coleman; on the clauses in the Glasgow Police Bill having reference to the prevention and mitigation of disease, by Dr. Ebenezer Duncan; on the ships and shipping trade of Great Britain, by N. Dunlop; on the iron ore industry of the north of Spain, by J. J. Jenkins; on the use of rosolic acid as an indicator, with additional notes on phenolphthalein and methyl orange, by R. S. Thomson; on architecture in Glasgow, by J. Sellars, jun., I.A.; on the water highways of the interior of Africa, with notes on slave hunting and the means of its suppression, by James Stevenson, F.R.G.S.; on a new seismograph, by Thomas Gray, B.Sc.; on the fertilisation of flowers, by Rev. A. S. Wilson, M.A.; on algin, a substance obtained from some of the commoner species of marine algæ, by E. C. C. Stanford; on chemical industries, by R. R. Tatlock; on nitroglycerine, dynamite, and blasting gelatine, by George McRoberts, manager of the Works of Nobel's Explosives Company; on the action of heat and the chlorides of phosphorus upon the water salts of hypophosphorus, phosphorus, and phosphoric acids, by Dr. Otto Richter; on a volumetric process for the estimation of cobalt and nickel, by Dr. John Clark; and, on the development and generic relations of the corals of the carboniferous system of Scotland, by James Thomson, F.G.S.

The society has at present 19 honorary, 10 corresponding, and nearly 700 ordinary members, and is about to enter on its eighty-first session. In addition to the ordinary meetings of the society, held fortnightly, there are sections for architecture, biology, chemistry, sanitary science and social economics, and geography and ethnology.

RESEARCHES ON SPARK SPECTRA

The Disappearance of Short Lines

IT was shown in a former Report of this Committee (Southampton meeting) that the spectra of metallic solutions were the same as those from metallic electrodes line for line, even short and weak lines being reproduced. The principal difference observable in the two spectra was a lengthening of the short lines when spectra were taken from solutions, so that discontinuous lines became long or continuous lines. A few instances of short lines disappearing have also been noticed, but such disappearances occur only when the lines are so short, mere dots, in fact, that no solution can contain a quantity of the metal sufficient to yield an image of them. Certain very short lines in the spectrum of metallic zinc are an example of this. Very short lines in the spectrum of aluminium were not reproduced by solutions of the chlorides except when the solutions were very strong, and then they always appeared. It may thus be seen that the quantity of metal present in the compound determines the presence of these lines.

The Lengthening of Short Lines.—It was remarked that in certain cases metallic electrodes showed a different spectrum according to whether the spark was passed between dry or wet electrodes. Thus it was pointed out that when iridium electrodes are moistened with calcic chloride, discontinuous lines which are very numerous in this spectrum become continuous; and on further examination into this matter it has been found that even moistening with water has the same effect. Hence the supposition, of which there seemed some possibility but no proof, that a chloride of the metal was formed is found to be untenable. The very short lines in the spectrum of zinc were lengthened by the action of water upon the electrodes. It has now been proved beyond doubt that this peculiar variation in the spectra is caused by the cooling action of the water upon the negative electrode, which in effect is the same as a strengthening of the spark, since by heating the electrodes a reverse action is the result.

Alterations in the Spectrum of Carbon.—As already stated in the previous Reports, graphite electrodes have been generally employed for the production of spark spectra from solutions. A portion of the work in connection with this subject included an investigation of the effect of water and of saline solutions in varying the spectrum of carbon. It will of course be readily understood that as carbon is capable of combining with oxygen and nitrogen, that different spectra might be obtained by making one or other of these gases the atmosphere surrounding the electrodes, but it is not so easy to explain why graphite points should give two different spectra in air when dry, and a third spectrum, again different, when moist, the same spark conditions being maintained.

Three such spectra have been photographed, but without the aid of maps their peculiarities are not capable of exact description. The maps which were drawn were presented to the Royal Society, together with a communication on this subject, three months since, so that they are not at present available. It may be said, however, that the difference between the two spectra taken from dry electrodes in air consists of the omission of a certain number of the less refrangible lines, which lines have undoubtedly been identified with carbon.

Spectra of the Non-Metallic Constituents of Salts.—A long series of experiments has been made with the object of determining the non-metallic elements which are capable of yielding spark spectra when in combination with the metals. Fluorides, chlorides, bromides, iodides, sulphides, nitrates, sulphates, selenates, phosphates, carbonates, and cyanides yield nothing. On the other hand, hydrochloric acid solutions of arsenites and antimoniates yield the spectra of arsenic and antimony. Borates and silicates in solution yield very characteristic spectra of the non-metallic constituents, but if the solutions be prepared from sodium salts the lines of the metal do not appear in the case of borates, and only the strongest sodium line ($\lambda = 3301$) can be observed in the spectra of silicates, even when concentrated solutions are used.

Line Spectra

BORON Wave-lengths	SILICON Wave-lengths
3450·1	2881·0
2497·0	2631·4
2496·2	2541·0
	2528·1
	2523·5
	2518·5
	2515·5
	2513·7
	2506·3
	2435·5

These are the first spectra of boron and silicon obtained from metallic salts.

[1] Report of the Committee on the Comparison of the Spark Spectra of the Elements with Spectra of Solutions of their Compounds, drawn up by Prof. W. N. Hartley.